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FEDERAL COMMUNICATIONS COMMISSION
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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of

New Personal Communications
Services

) Gen. Docket No. 92-333
) Gen. Docket No. 90-314
) ET Docket 92-100

Comments on Proposals
Offered for Comment
from
Telmarc Telecommunications Inc.

)
)
) November 9, 1992
)

COMMENTS ON NOTICE OF PROPOSED RULE MAKING

POSITION SUMMARY

Pursuant to the Commission's Notice of Public Rulemaking (NPRM), relating to the Commission's General Docket 92-333, and General Docket No. 90-314, the Commentor, Telmarc Telecommunications Inc., hereby provides comments on the set of proposed rulemaking for the proposed allocations of spectrum for PCN, Personal Communications Networks. It is the position of the Commentor that the issues raised by the Commission are all valid issues and go to the heart of establishing a new and innovative communications service on a national basis. Furthermore, the Commentor specifically proposes to demonstrate that the positions suggested have a single optimal choice in each case, and that the choice is, overall, in the maximum interest of the public.

The Commentor's summary initial positions are as follows:

(i) PCN/PCS is a wireless telecommunications service that provides access to all users, delimited only by coverage or frequency access, allowing at a minimum toll grade quality voice service, and access to a wide variety of other voice and data services, provided either through the new PCN network or using existing or to be developed service providers, extra the network. The service should allow seamless national capability that is transparent to the user and the service must be provided on a highly cost effective basis that allows universal access.

(ii) The two factors that are the bases for success in the new wireless band are; technology for best performance and spectrum access for best utilization of assets. The Commentor suggests that 20MHz be selected as the value per carrier, with an additional 10Mhz in reserve. The intent is to create the maximum number of economically viable contenders to provide the best set of offerings to the public while challenging the technology to maximize use of spectrum.

RECOMMENDATION 1:

IT IS RECOMMENDED THAT THE COMMISSION AWARD, INITIALLY, 20 MHz BANDWIDTH TO EACH LICENSEE AND THAT IT RETAIN 10 MHz PER LICENSEE IN RESERVE FOR FUTURE USE. FURTHER, IT IS RECOMMENDED, THAT THE COMMISSION BASE THE ALLOCATION OF THE ADDITIONAL FREQUENCY ON THE BASIS OF COMPETITIVE PERFORMANCE BY ALL CONTENDERS IN THE BANDS IN USE.

(iii) The Commentor argues from basic microeconomic principles and from direct experience in the Cellular market that the public is benefited from the maximum competition possible, and that a duopoly is a de facto monopoly. Three players are needed, at a minimum, in a market to have minimal competition and in fact experience demonstrates that five is the optimal value, allowing one or two to become secondary and three to vie for market share. The Commentor recommends that the Commission award at least four if not a full five licenses. Specifically, the Commentor suggests that three be issued ab initio and that a fourth and fifth be assignable in the event that adequate competition does not result in a reasonable period of time.

RECOMMENDATION 2:

IT IS RECOMMENDED THAT THE COMMISSION AWARD THREE INITIAL LICENSES AND THAT AN ADDITIONAL TWO BE HELD IN ABEYANCE FOR TWO YEARS. AFTER THAT TIME, THE COMMISSION SHOULD AWARD AN ADDITIONAL SET OF LICENSES, SUBJECT ONLY TO THE PROVEN VIABILITY OF THE MARKET LACE. IT SHOULD BE THE OBJECTIVE OF THE COMMISSION TO ALLOW MAXIMUM COMPETITION TO MAXIMIZE THE PUBLIC BENEFIT OF BEST PRICING.

(iv) The Commentor has stated earlier and elsewhere that, if the goal is a national seamless interoperable network, that this can be most efficiently and effectively obtained through the development of coalitions amongst separate license holders. The Commentor is currently working in such a coalition and this represents an existence proof of this approach. The coalition approach, clearly and unambiguously, demonstrates the ability to coalesce around one effective standard. The Commentor thus is

opposed to any national standard as being not only unnecessary but highly anti-competitive.

RECOMMENDATION 3:

THE RECOMMENDATION IS TO REQUIRE IN-BAND INTEROPERABILITY, THROUGH STANDARDS, DEVELOPED THROUGH A LIMITED NUMBER OF COALITIONS OR CONSORTIA, BUT PROVIDING MAXIMUM COMPETITIVENESS AMONGST ALL VIABLE ENTRANTS, AND ALLOWING INTERBAND COMPETITIVENESS VIA TECHNOLOGY AND OPERATIONAL EFFICIENCIES. FURTHERMORE, IT IS RECOMMENDED THAT NO NATIONAL LICENSE BE ISSUED TO ANY CONTENDER AND THAT MARKET FORCES BE ALLOWED TO GENERATE THE MARKET.

(v) The Commentor recognizes, as does the Commission, that there is significant value to the licenses and that the value should be recognized ab initio and the public at large should benefit from that perceived value. Furthermore, the most fair and equitable process for obtaining this asset is through an open competitive simultaneous bidding process, and not a lottery. Closed bids are a secondary option, yet reduce the potential economic return to the taxpayers while potentially reducing the risks of the bidders. Extensive studies have been performed on these processes and are detailed in these Comments. However, the most efficient and effective proposal from a public policy perspective is open simultaneous competitive bidding. The true value of the asset can then be expressed. The second option is closed simultaneous bids. The issue of open or closed sequential bidding leads to frenzy feeding of pricing and distorts a true fair market value for the asset. Thus the Commentor suggests that any set of sequential bidding not be followed. The experience from the Cellular lotteries should provide adequate experience to demonstrate the lack of public equity in the process.

RECOMMENDATION 4:

IT IS RECOMMENDED THAT THE COMMISSION HAVE COMPETITIVE BIDDING, AND DOES NOT CONSIDER LOTTERIES OF ANY FORM, AND THAT THE COMPETITIVE BIDDING BE DONE IN A SIMULTANEOUS FASHION, AND IN A MANNER THAT ALLOWS MAXIMUM COMPETITIVENESS AMONGST ALL OF THE CONTENDERS. SPECIFICALLY, THE OPTIMAL CHOICE IS A FULL OPEN BIDDING PROCESS BUT BARRING THE COMPLEXITIES OF SUCH A PROCESS THE SECOND OPTIMAL RECOMMENDATION IS THE CLOSED, SEALED BID PROCESS, SIMULTANEOUSLY, FOR ALL AREAS SELECTED, WITH QUALIFIED BIDDERS. A QUALIFIED BIDDER SHALL BE ONE WHO HAS CLEARLY DEMONSTRATED BOTH DEVELOPMENTAL COMMITMENT THROUGH AN EXPERIMENTAL TRIAL OR TECHNOLOGY DEVELOPMENT, AS WELL AS DEMONSTRATING FINANCIAL RESOURCES ADEQUATE TO EXECUTE THE BID PAYMENT.

(vi) The Local Exchange Carriers (LECs) are in a strong monopolistic position in each of their markets and are just now, after extensive work on the part of other carriers, opening up their networks for access to these parties. The Commentor notes that in the prior ONA Dockets that the LECs were, for the most part, unresponsive and uncooperative in addressing open access. Thus they have retained and continue to retain a bottleneck hold over local access. The Commentor has stated in this Preliminary Comment and elsewhere that fair and equitable access is the goal from all, especially as a necessary goal for the achievement of the PCN Objective. The Commentor has also argued that the LECs are disaggregatable into three entities; retail, wholesale transport and wholesale switching. Any PCS carrier is performing the retail and wholesale transport functions and will continue to rely upon the LEC for wholesale switch access. This latter function is currently provided at a rate that far exceeds the rate internal to the LEC, in some cases by more than a factor of ten. Thus, the Commentor strongly urges the Commission to deny the LECs access to wireless PCN licenses as both anticompetitive and sustaining and building their monopolistic powers.

RECOMMENDATION 5:

IT IS RECOMMENDED THAT THE COMMISSION ALLOW THE LECs TO HAVE ACCESS TO PCN FREQUENCIES ON A BASIS THAT IS EQUAL TO ANY OTHER BIDDER, FOLLOWING THE BIDDING PROCESS THAT ALL OTHERS WILL ENTER INTO AND THAT THEY MUST, WITHIN NINETY DAYS AFTER THEIR WINNING ANY BID, SUBMIT, COMMIT, WARRANT AND GUARANTEE, TO ANY AND ALL OTHER ACCESS CONTENDERS, EQUAL AND EQUITABLE ACCESS AND PRICES TO ANY AND ALL DISAGGREGATED AND UNBUNDLED ELEMENTS OF THE LEC NETWORK, INCLUDING BUT NOT LIMITED TO CO-LOCATION SWITCH ACCESS, CO-LOCATION FACILITIES ACCESS, ANDY ANY AND ALL OTHER UNBUNDLED ACCESS POINTS. IF ANY LEC, WINNING A BID, FAILS TO CONFORM TO THE POLICY, THEN IT LOSES ITS BID AND FORFEITS ITS BID FEE TO THE U.S. GOVERNMENT.

(vii) The existing Cellular companies have stated in many venues, openly and without reservation, that they see no need for additional spectrum. The spectrum allocated to them is consistent with the allocations to the new proposed services. The Commentor thus recommends that the Commission take no actions towards allowing them to have additional spectrum, since such spectrum was not needed nor will it allow competitive forces to act.

RECOMMENDATION 6:

IT IS RECOMMENDED THAT ANY CURRENT CELLULAR COMPANY, ITS PARENT, MAJORITY SHAREHOLDER, OR OPERATOR BE DENIED ADDITIONAL FREQUENCY SPACE IN THE NEW BAND, IN MARKETS IN WHICH THEY CURRENTLY SERVE, AS BEING DEMONSTRABLY ANTICOMPETITIVE.

(viii) PCN/PCS as a service provides access to a universal base of subscribers, and as such is a Common Carrier. The system must have open interfaces, open architectures, and must provide a platform for the inclusion of a wide variety of third party service providers as well as access to existing LEC networks and IEC networks. The Commentor sees no other option except in those cases of clearly private networks, yet the Commentor recommends that such networks not use this band.

RECOMMENDATION 7:

IT IS RECOMMENDED THAT THE SERVICE BE REGULATED AS A COMMON CARRIER, ALLOWING FULL AND OPEN ACCESS WITH DETERMINED, DEFINED AND PUBLISHED TARIFFS, TO ALLOW MAXIMUM UTILIZATION OF THE NEW ACCESS TECHNOLOGY.

(ix) The ability to provide a service that has the capability of ensuring a seamless interoperable network is based upon the ability of a set of service providers to agree in a coalition fashion on a common set of access schemes and access methods. This can be achieved, as already stated, by economic forces and not necessarily mandated by fiat. The example of the existing coalition discussed in this Preliminary set of Comments clearly demonstrates this fact. Standards are then obtained in the most efficient fashion by market forces and not by market dominance. The lack of an AT&T like entity makes this approach the first time such an evolution will have occurred in any country. The Commission has the unique opportunity to clearly demonstrate the capability of U.S. companies to cooperate and agree to work together without the encumbrances of undue supervision and direction. The Commentor support Standards de facto rather than Standards de jure.

The Commentor also recommends that a national Wireless Technology Resource body be established that will provide a common ground to discuss, analyze, develop, evaluate and generate new technologies and standards for this industry. The Commentor has previously suggested that an institution currently performing DoD research in similar areas may be the proper vehicle for such a focus and the Commentor has specifically recommended the MIT Lincoln Laboratory for such a role. Thus the Commentor suggests that at the current time, economic and technical forces will result in a Standard de facto and that there is a clear and compelling need to establish a National Resources Technology Body and the the time is ripe to move DoD competence into the commercial sector.

As such the Commentor recommends that an institution such as MIT Lincoln Laboratory be used as that vehicle.

RECOMMENDATION 8:

IT IS RECOMMENDED THAT THE COMMISSION ALLOW TECHNOLOGY TO BE USED TO RESPOND TO THE OVERWHELMING MARKET FORCES, DRIVEN BY QUALITY AND COST, TO CREATE AND SUSTAIN, DE FACTO COALITIONS TO ASSURE COMMONALITY OF SERVICE AND THE ESTABLISHMENT AND SUSTAINMENT OF A SEAMLESS AND INTEROPERABLE NATIONAL NETWORK. THAT THE COMMISSION MOVE WILL ALL SPEED IN LICENSING THE NEW BANDS, AND PRESS ALL SUCCESSFUL LICENSE HOLDERS INTO RAPID DEPLOYMENT OF THEIR SERVICE. THAT THE COMMISSION, WITH THE CONSENT OF THE CONGRESS, SUGGEST, RECOMMEND, AND IF NECESSARY SUPPORT THROUGH APPROPRIATE APPROPRIATIONS, THE ESTABLISHMENT OF A NATIONWIDE PCN LABORATORY, TO ACT AS THE INDUSTRY FOCUS FOR THE NEW INDUSTRY, INITIALLY SUPPORTED BY THE GOVERNMENT AND SUBSEQUENTLY TOTALLY SUPPORTED BY THE INDUSTRY. IT IS FURTHER RECOMMENDED THAT AN FCRC, SUCH AS MIT LINCOLN LABORATORY, BE NAMED THAT CENTER OF EXCELLENCE, FURTHER ALLOWING THE TRANSFER OF DEFENSE BASED TECHNOLOGY INTO THE PUBLIC SECTOR, THUS FURTHER MAXIMIZING THE PUBLIC BENEFIT.

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RULEMAKING OBJECTIVES

The Commission has described in its NPRM the four objectives that it has established for PCN services. These are as follows:

(i) Competition: Namely, that there exist an adequate amount of competition so that, on one hand, the public is best served with a price and feature competitive service offering, and, on the other hand, that the spectrum is effectively assigned for optimal use of a limited resource. Furthermore, the competitors should and must be committed to a timely and cost effective deployment of the system and services.

(ii) Rapid Deployment: That the service be introduced into the market as quickly as possible. At one extreme, such introduction could be done using existing limited CT-2 technology, yet resulting in the same market lack of acceptance that CT-2 saw in the United Kingdom, or at the other extreme, waiting until the best system is designed to satisfy all the common needs such as GSM in Europe, and also resulting in dramatic delays and lacking in actual performance. Both extremes clearly do not take U.S. technical innovativeness into account. Thus the Commission is pressing, with all due speed, to field the best system with limited research and development, leveraging on the many technological innovations provided in the Pioneer's Preference motions. However, the Commission, in its deliberations on Pioneer Preference, chose some time certain as the cutoff date for the development of technology. Yet, technology is evolving and rapid deployment may be possible in the context of an environment that allows change and evolution. This factor must be part of the overall decision process. It can further be argued that allowing the Pioneers Preference filers recognition for their contributions in addition to the assignment of license award may and can add to the timeliness as well as universality.

(iii) Universality: Universal Service is a concept that on one hand is a social policy and on the other hand is balanced with an economic imperative. As best understood, universality, or universal service, is construed to be the availability or accessibility, in a reasonable time frame, to this service, by all of the people in the United States, and if possible, on a global basis. As a social policy, universal service, demands financial underpinnings that may not be justified by rational financial investments. The REA was such an example. As a means of ensuring public accessibility in the context of rational economic

returns, universal service begs the question of common interfaces and commonality of access. The latter is key to the success of this service.

(iv) Diversity: Diversity of Services, as construed by the Commission, has also two extreme views. Both views however reflect the intent of providing the public with the greatest breath of accessibility possible. On the one extreme, diversity of services says that the service provider per se provide and ensure that such services are available. The second extreme is that the service provider provide a network access that is an open architecture interface, allowing any and all third party service providers access to the transport capabilities and to the public. The latter position states that the Licensee has the obligation to provide access to providers to allow them to provide the diverse set of services to the public.

Summarizing these objectives, the allocation procedure is then deemed to be done in such a way as to create the most competitive environment as possible, providing a rapid development and deployment of the infrastructure, providing a seamless interoperable network, that has an open architecture that is accessible by and third party service provider to reach the public with their offerings, in a cost effective and competitive fashion.

NEW SERVICE OBJECTIVES

The objectives of a new wireless service offering have been discussed in many of the comments directed at the Commentor and presented to the Commission. The Commentor had presented previously the following definition of the proposed service:¹

"... PCN must allow ... the consumer a service that is measurable and comparable, and the ultimate discriminator is that of price versus service...a communications service that allows, at the least, portable access and, at the most ubiquitous access ... a wireless telecommunications service, that allows ready and immediate access, to any and all

1. See Telmarc Telecommunications Inc, FCC Filing for Pioneer Preference, General Docket 90-314, PP-76, May 4, 1992 and in Reply to Comments, General Docket 90-314, PP-76, June 25, 1992. In these filings, the Petitioner, Telmarc Telecommunications Inc. articulated in detail concerning the definition of PCN services and their proper design and impact.

communications networks, from any wireless configuration, in a land based mode, providing toll grade quality voice service, at a minimum."

The Commentor clearly understands the goal of the service, as one that maximizes the public good and benefit, by providing a PCN service as defined above and doing so within the environment of an innovative and entrepreneurial milieu. The Commentor argues, further, that a path to achieving that goal must contain two key elements: service quality and cost effectiveness.

The Commentor argues that at the heart of a successful PCN service is the ability to allow the public the choice on the basis of price and quality, and that, as such, results in a commodicizable offering. In effect, the offering makes PCN, de minimus, a commodity in the sense that it is differentiated only in terms of its branding, exclusivity of distribution, or enhancements, that make one offering different from another. Further, the Commentor argues that the interface offered by the LECs can also be commodicizable, in that it may be bought and sold, may be undifferentiated in the process, may be treated as a good, and may be fungible.

The Commentor further argues that the service cost is equally important to its success and thus argues that the technologies it has developed are uniquely qualified to meet those needs. Specifically the Commentor argues that the current cellular and any, if not most of the proposed PCN approaches, fail to address the PCN cost problem from a total system approach. The Commentor suggests that a Goal for the PCN service can be articulated based upon the Commissions current objectives. This goal, as stated below, can be used as the litmus test for all proposals, in a truly analytical framework.

GOAL

THE GOAL OF THE ESTABLISHMENT OF NEW PCN SERVICES IS TO PROVIDE TO THE PUBLIC, SEAMLESS AND INTEROPERABLE NATIONAL WIRELESS TELECOMMUNICATIONS SERVICES THAT USE THE MOST INNOVATIVE TECHNOLOGY AND TECHNIQUES AND IS PROVIDED IN AS COMPETITIVE ENVIRONMENT AS POSSIBLE, TO ENSURE THE MAXIMUM BENEFIT TO THE CONSUMER IN THE SHORTEST TIME.

This goal is clear in that it meets the overall public good requirement that of combining market efficiencies in innovation and price, with the limited control of seamless service. There are two options that can be followed. One extreme is to require that every user in every city can use the same terminal in every other location. The other less extreme position is that a user of an allocated band may move freely from city to city with the same terminal, and remain operable in that band. These alternatives are analyzed in the body of this Comment.

SERVICE DEFINITIONS

The definition of the PCN services as provided by the Commission is broad and all encompassing. As the Commentor has already stated, there should be a minimal and clearly understood baseline of capability that must be provided by any and all service providers. This minimum capability is the enabling capability that is necessary, but not sufficient for a successful deployment of a PCN service. These capabilities are as follows:

(i) Open Architecture: The service must be designed with an open architecture format, allowing the delivery of stable and open interfaces, such interfaces allowing any third party to access the network in a totally unbundled fashion.

(ii) Seamless: The service should be accessible in an identical fashion independent of location or provider. There should be no significant access changes or modifications that will result in any ambiguity in the mind of the public.

(iii) Interoperable: The system must technically work the same way in one location as it does in any other. This does not mean that each system must interoperate with each other, it does mean that each system must have an interoperable element in each location.

(iv) Type of Service: The service, at a minimum, must support any wireless user needing voice grade access. A wireless user can be in any configuration, standing, moving, inside or outside. A second level of service offerings is that of data. The Commentor is concerned that the use of this spectrum for high speed data is inappropriate as it will argue latter.

(v) Level of Service: The level of the basic service, namely voice, should at a minimum be that of toll grade voice.

(vi) Cost of Service: The cost of the service to the public should and must be targeted at a level competitive with that of any other displaceable service offering. Thus it is important that the service providers maintain their costs and the the FCC realize an economically efficient competitive bidding process, so as not to unduly burden the public.

(vii) Extensibility: The service should have the capability of growing to meet increased public demand for both basis access as well as enhanced service access, without material changes in its design or deployment.

(viii) Commodicizable: The service provided by any one carrier, as a basic service providing voice, should be fungible to any other. Moreover, the service should be fungible vis a vis switched wireline LEC voice. Then and only then can the public have a clear economic choice, and then and only then will the monopolistic bottleneck appear breakable.²

The Commentor strongly argues that the Commission reflect upon these specific characteristics of the PCN offering and incorporate them into its requirements for Service Providers.

FREQUENCY ALLOCATIONS

There are several key Observations that are first critical to developing the Recommendation. These Observations are as follows:

(i) TECHNOLOGY EXISTS AND WILL BE DEVELOPED WHICH WILL ALLOW A SIGNIFICANT DENSITY OF VOICE CHANNELS PER UNIT SPECTRUM AND PERMIT FREQUENCY SHARING WITH OTHER FIXED MICROWAVE USERS. FURTHERMORE, THE SAME TECHNOLOGY WILL ALLOW A SIGNIFICANT AMOUNT OF VOICE CHANNELS PER UNIT SPECTRUM PER SQUARE MILE. SUCH TECHNOLOGY WILL BE ABLE TO PROVIDE CAPACITY TO SIGNIFICANT MARKET PENETRATION IN MOST MAJOR MARKETS.

Clearly, in the Pioneer's Preference Process the Commission was shown a wide variety of access schemes that made extensive use of spectrum. CDMA technology has been demonstrated to provide ten to twenty times the number of voice channels per unit frequency that analog does.

(ii) TECHNOLOGY CHANGES DRAMATICALLY IN SEVEN YEAR CYCLES. SUCH CHANGES WILL ALLOW FOR CONTINUING INCREASES IN SPECTRUM UTILIZATION AS WELL AS ENSURING UPWARDLY COMPATIBLE SYSTEMS.

Rather than selecting a single technology and staying with it with a long period, the system should be designed to be flexible and to accept change. Two factors make this change more acceptable. First, there are de minimus scale economies so that with efficient access schemes, the costs

2. A commodicizable service is one in which the offering from one provider does not differ in kind with the offering of any other provider. As noted in Henderson and Quandt, *Microeconomic Theory*, McGraw Hill (1980), pp. 145-146, a commodity is homogeneous and non-differentiable. If one were to consider the availability of wireless dialtone, connection and access, as the commodity, then it is clearly undifferentiated between players, other than the quality of the communications link. If, further, the quality is kept common, then it truly becomes a commodity. In such an environment, a single equilibrium price will result, driven by the ability of the producer with the lowest marginal cost. This price will be significantly lower than that of either a monopolistic or duopolistic market. For the purpose of this Comment, the basic element commodity is defined as wireless dial tone, connection and access. There are other elements that may also be commodicizable.

of changing are small.³ Second, technology is more and more embedded in software and the fact is clear that "silicon is free" so that the continuing investment is in the software elements. As such, software itself continually migrates and is the dominant change agent.⁴

(iii) TECHNICAL CHARACTERISTICS OF THE NEW BAND ARE WELL KNOWN TO THOSE WHO HAVE WORKED IN THE BAND AND ITS ENVIRONS AND IT IS EXPECTED THAT THERE WILL BE MODIFICATIONS TO EXISTING TECHNOLOGY THAT WILL OPTIMIZE THE INITIAL SYSTEMS.

The Commentor has worked extensively in this frequency band and its characteristics are well understood to any trained in the art. Thus it is anticipated that there should be no significant surprises in the design and deployment of systems in the 1.8 GHz band.⁵

(iv) TECHNOLOGICAL CHANGES WILL OCCUR MORE EFFECTIVELY IN THE SOFTWARE IN THE SYSTEM AND NOT IN THE HARDWARE. CURRENT ARCHITECTURES ARE GENERALLY MUCH MORE FLEXIBLE THAN ANALOG SYSTEMS, THUS ALLOWING UPWARD MIGRATION THROUGH SOFTWARE.

As already stated, software will dominate the system paradigm. More importantly, by digitizing the signals at the RF end, the processing will be able to be done as early as possible in the system. Possibly in late first generation PCN systems, but clearly in second generation PCN systems, the system will be all software defined and processed.

Based upon these observations, and based upon the Goal established for the PCN services, the argument proceeds as follows:

1. GOAL

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3. See McGarty [1992,2], Wireless Communications Financial Model, Advanced Telecommunications Institute Conference, Carnegie Mellon University, June 16, 1992. In this paper, the author uses the detailed models for the wireless market, showing that under the assumptions of CDMA, co-location, and separating the set from the service, that the scale factors in the financial models of a wireless system are de minimus. Specifically, the average costs and the marginal costs rapidly equate at low market penetrations, specifically 10,000 customers. This model builds upon the analysis in McGarty [1989], Business Plans, Wiley. This is in sharp contrast to other systems, such as satellite and terrestrial systems, as shown in McGarty and Warner, [1977], IEEE Vol AES-13, No 5, pp. 508-510, which demonstrates the dramatic scale in such systems. This is a generally surprising result and differs also from that of the current analog cellular systems.
 4. The Commentor notes that the change from analog to digital was effected in a three year process, only after the industry recognized a compelling need for additional capacity in light of the limitations of the analog system. It took, furthermore, only eighteen months for the CTIA to arrive at two "Standards", TDMA and CDMA.
 5. See McGarty [1976, 1] IEEE Vol AES-12, No 1, pp. 42-54; the author presents a detailed analysis of the effects of multipath on propagation in the 1+ GHz band in and around Boston. Extensive fading and time of arrival data are presented. In Schneider and McGarty [1978, 1], IEEE Vol COM-26, No 2, pp. 235-246, this data was applied to CDMA signaling in the same environment using the Schneider-McGarty-Viterbi multipath enhancement system. The results clearly show that CDMA functions effectively in this environment and that in fact multipath that be used to improve signal processing.

THE GOAL OF THE ESTABLISHMENT OF NEW PCN SERVICES IS TO PROVIDE TO THE PUBLIC, SEAMLESS AND INTEROPERABLE WIRELESS TELECOMMUNICATIONS SERVICES THAT USE THE MOST INNOVATIVE TECHNOLOGY AND TECHNIQUES AND PROVIDED IN AS COMPETITIVE ENVIRONMENT AS POSSIBLE, TO ENSURE THE MAXIMUM BENEFIT TO THE CONSUMER IN THE SHORTEST TIME.

OPTION 2.1

THE COMMISSION AWARDS 20 MHZ OF BANDWIDTH TO EACH PROVIDER.

This amount of bandwidth is more than adequate for the provision of any type of service. The QUALCOMM CDMA approach can provide 400 voice channels, instantaneously, in a 1.25 MHz band, and using the multiple of seven for cell duplication, leads to 8 channels in 10.0 MHz for transmit and 10 MHz for receive. ⁶These eight channels can provide 3,200 instantaneous voice channels, and each cell may be as small as 2 miles for a regional market. This means that for a 4,000 square mile market, such as Boston (35 mi radius), there are in excess of 150,000 instantaneous voice channels. Assuming a 5% peak usage in traffic loading, this reflects a capability of handling traffic from 3,000,000 users. This is close to 75% of the current MSA population. This is the suggested OPTION, and this leads to alternatives OPTIONS 3.1 and 3.2.

OPTION 2.2

THE COMMISSION AWARDS 30 MHZ OR MORE BANDWIDTH TO EACH PROVIDER.

The Commission allows larger bandwidths in anticipation of some unknown technology providing enhanced capabilities. Given the capabilities of the 20 MHz and the availability of the technology, this OPTION is unacceptable since it makes inefficient use of spectrum, ab initio.

OPTION 3.1

THE COMMISSION HOLD 10 MHZ IN RESERVE FOR FUTURE ADDED ALLOCATION BASED UPON NEED OR FOR ADDITIONAL ENTRANTS.

As the market grows, it will be inevitable that new uses and users will evolve. This has always been the case with successful services. The providers who have demonstrated effective and efficient use of spectrum, should have access to additional amounts, after having demonstrated such.

6. See QUALCOMM Request for Pioneer Preference, General Docket 90-317, PP 68, May 4, 1992, Appendix A. This document details the performance of the CDMA system in the presences of standard operational elements.

OPTION 3.2**THE COMMISSION RETAINS A SOLE 20 MHZ ALLOCATION.**

This is a default position that retains the initial allocations and anticipates no growth. It is a negative position and is unacceptable.

4.0 RECOMMENDATION

IT IS RECOMMENDED THAT THE COMMISSION AWARD, INITIALLY, 20 MHZ BANDWIDTH TO EACH LICENSEE AND THAT IT RETAIN 10 MHZ PER LICENSEE IN RESERVE FOR FUTURE USE. FURTHER, IT IS RECOMMENDED, THAT THE COMMISSION BASE THE ALLOCATION OF THE ADDITIONAL FREQUENCY ON THE BASIS OF COMPETITIVE PERFORMANCE BY ALL CONTENDERS IN THE BANDS IN USE.

NUMBER OF LICENSES

The number of licenses awarded must address several factors; public benefit, competitive balance, financial risk, and feasibility of service. Clearly, one license an extreme that the Commission has not considered. However, there are several Observations that are the basis of the proposed position that are essential to understanding the current true options available. The Observations are:

(i) THERE EXIST PARTIONABLE AND SEPARABLE ELEMENTS IN TELECOMMUNICATIONS SERVICE PROVISION:

Communications services elements are partionable and separable and providable by separate and distinct parties. The underlying four elements of a communications service are the interface(Phone), the transport (the process of getting from the terminal to the switch), the interconnect (or the switch), and the overall control elements. The Commission began in the Carterfone decision to understand and to break apart the bundled elements so that they may be more effectively offered TO THE CONSUMER IN THE SHORTEST TIME. The current situation of fully unbundled and fully competitive terminal provision is a symbol of the wisdom and success. Currently, PCN offers the opportunity to do this to the transport mechanism. ⁷

7. See McGarty [1992,1], Alternative Networking Architectures; Pricing, Policy and Competition, pp. 218-270, in Building Information Infrastructures, B. Kahin Ed, McGraw Hill, NY. In this paper, the author demonstrates the decomposition of networks into four common elements; interface (the set), transport (the connection), interconnect (switching) and control. The author further demonstrates that differing communications systems reflects world view of the designers and specifically shows the dramatic difference in hierarchical systems like the phone company and distributed systems like LANs and WANs.

(ii) SEPARABLE PROVISIONING CAN ONLY WORK IN AN ENVIRONMENT OF LEC SEPARATION AND PRICING BASED ON FAIR AND EQUITABLE MARGINAL PRICING:

PCN is a local access service that needs to have fair and equitable access to the local exchange carriers (LECs) switch. As such, by partitioning the interconnect from the transport, and ensuring fair and equitable marginally priced access to local interconnect, separable from transport, will ensure that all competitors are able to compete on a common basis.

(iii) IEC VERTICAL INTEGRATION CAN AND WILL DISTORT LOCAL ACCESS IF NOT CONTROLLED IN THE SAME MANNER AS THE LEC, THROUGH FAIR AND EQUITABLE SEPARABLE ACCESS ELEMENTS:

PCN local access is only one element. Clearly IEC access is also critical. The IECs can distort an open market in two ways. First, through lack of common interfaces, they can cause undue costs of access to the interexchange network, and thus make one carrier obtain an advantage over another. In view of the fact that equal access concepts have not been defined or even addressed in this new access mode, this represents a concern to all carriers. Secondly, and IEC may and has demonstrated in the AT&T filing, its interest and intent to file for a PCN license. This would re-create a vertically integrated competitor, that de facto re-creates the pre-divestiture Bell System. This can be a chilling effect on all other contenders.⁸

(iv) TECHNOLOGY AVAILABLE FOR PCN TRANSPORT IS SUCH AS TO PROVIDE DE MINIMUS SCALE ECONOMIES THUS ENSURING DE MINIMUS BARRIERS TO ENTRY.

The PCN technology for infrastructure can be shown to exhibit de minimus scale economies. As shown in Exhibit 1, the capital per subscriber in a CDMA system, is at most \$200 per subscriber when the number is less than 50,000 and drops to less than \$150 per subscriber and generally stays there above 100,000 subscribers. Thus the capital per subscriber is one fifth that of analog cellular and in addition it is shown that the marginal and average values are identical over most of the range. Thus there are no scale economies.⁹ The Commission in its arguments in the

8. Many reports detailed these offenses, specifically the report, Telecommunications in Transition, Committee on Energy and Commerce, U.S. House of Representatives, November 3, 1981, is one such report issued just prior to the divestiture announcement in January, 1982.

9. This is demonstrated in a paper by McGarty [1993] presented at Carnegie Mellon University, Advanced Telecommunication Institute Conference, February, 1993. As a simple example for CDMA; each cell handles 400 instantaneous voice channels, and a cell covers approximately 20 square miles. Five cells handle 2,000 instantaneous voice channels. Each cell can be extended by 9 re-radiators to handle 200 square miles, so that five cells can handle 1,000 square miles. This represents 50% of the metropolitan Boston area. Assuming that the peak loading is 4%, this means that the system can handle 50,000 users. This usage model has been demonstrated in detail by Mayer, in The Uses of Time, Social Impacts of Telephones,

NPRM has had extensive reliance on the issues of economies of scale and/or scope. As has been demonstrated in the referred exhibit, there are no such economies. Thus the basis of the arguments on scale are without basis.

(v) DEMAND IS HIGHLY ELASTIC TO PRICE AND HIGHLY CROSS ELASTIC TO QUALITY AND PRICE.

Demand, initially, is a displacement demand. It is based upon disposable income and as such must come from other sources of expenditure. The two drivers are price and quality.¹⁰

Based upon these observations, and based upon the Goal established for the PCN services, the argument proceeds as follows:

1. GOAL

THE GOAL OF THE ESTABLISHMENT OF NEW PCN SERVICES IS TO PROVIDE TO THE PUBLIC, SEAMLESS AND INTEROPERABLE WIRELESS TELECOMMUNICATIONS SERVICES THAT USE THE MOST INNOVATIVE TECHNOLOGY AND TECHNIQUES AND PROVIDED IN AS COMPETITIVE ENVIRONMENT AS POSSIBLE, TO ENSURE THE MAXIMUM BENEFIT TO THE CONSUMER IN THE SHORTEST TIME.

OPTION 2.1

THE COMMISSION SHOULD AWARD THREE SEPARATE LICENSES IN EACH REGION.

If the Commission views the PCN market as a new opportunity to create a new set of service offerings, and if the Commission desires to have competition in this new service offering, then the minimum number of new licenses is three. Two or less will create a de facto monopoly and will not allow the Commission to achieve its goal. Moreover, the number of license holders will also add to this competitive factor. This is the suggested OPTION and OPTIONS 3.1 and 3.2 follow.¹¹

de Sola Pool, MIT Press, 1977, pp. 225-245. If a cell, fully loaded is \$1 million, and a re-rad is \$50,000, then the total capital is approximately, \$7.5 million. This yields a capital per subscriber of \$150. Covering twice the area would increase the costs by \$10 per subscriber.

10. The demand elasticity to price is evident in the high churn in the Cellular systems. Some systems have experienced a churn as high as 6% per month. Such a churn would result in loss of all customers in fifteen months. That churn is due to the price wars between systems. In certain large metropolitan areas there are dealers who offer \$100 to a customer to change supplier, from B side to A side. The Dealer is paid \$300 to reprogram the chip for a new ESN number. The dealers costs are less than \$100, fully loaded, and they pay the customer \$100, leaving them with a \$100 profit. Price differences in such markets such as Boston, where the A side carrier has free service from 7 P.M. to 7 A.M. leads to dramatic imbalances in market share, about a two to one ratio.

11. See Porter, Competitive Advantage, 1985, Free Press, pp. 221-228. Porter demonstrates that a stable market configuration follows a semilogarithmic distribution where each competitor's share is a constant

OPTION 2.2**THE COMMISSION SHOULD AWARD FIVE LICENSE IN EACH REGION**

The number of competitors in any market is naturally limited by the size of the market, the share obtained by any set of layers and the number of customers obtainable by any player. In view of the de minimus scale in this business, clearly any small set of providers may be marginally profitable, but may not provide an adequate return on the investment. Typically, it has been shown in multiple studies, that the top three market players both make and sustain the market. Allowing four or five players in the market will clearly allow for clearing of the competition on the basis of price and performance. However, if the service is offered in a commodicizable manner, the existing two Cellular carriers are cross elastic and thus the duopoly is eliminated, and rates are now free to be non-monopolistic. Therefore, the competitive nature is satisfied with three, and five is not an appropriate immediate choice.

OPTION 3.1**THE COMMISSION SHOULD, AFTER AWARDING THREE, INDICATE THAT IT WILL AWARD TWO ADDITIONAL ONES AT A LATTER DATE TO MAXIMIZE COMPETITION.**

The three argued in OPTION 2.1 indicates an appropriate level of initial competition. In letter stages, it may be appropriate to issue an addition two to expand the service base. Thus a reserve position will assure maximum competition.¹²

OPTION 3.2**THE COMMISSION SHOULD AWARD ONLY THREE AND NO FURTHER.**

This is generally a static position that delimits the freedom of the Commission to meet the changes of the market, and as such in unacceptable.

OPTION 4.1

proportion of the next higher ranking competitor. Furthermore, and most importantly, it is shown that a market in a commodity, will generally have three dominant players in the ratio of 4:2:1 of share. The evidence for this seems to be overwhelming. This does not however indicate that a market cannot support five or more players.

12. See Porter, Competitive Strategy, 1980, Free Press, pp. 145-148. The author shows that despite extensive studies in the PIMS program where market share was linked to returns on investment, rates of return can be achieved by all competitors if there are minimum scale economies in the market. Specifically, although a commodicizable market creates three dominant players, lack of scale allows viable players in selected niches.

THE REMAINING TWO SHOULD BE AWARDED ON A TIME BASED SCHEDULE.

The award of the additional licenses can be time or event driven. In view of the fact that events may be subject to vague and conflicting interpretation, the time driven approach is most appropriate. Thus the Commission may, if necessary, issue two additional licenses after two years, or a period reasonable to assure continuing competitiveness.

OPTION 4.1

THE REMAINING TWO SHOULD BE AWARDED ON AN EVENT BASED SCHEDULE.

This OPTION is clearly unacceptable from the prior argument.

5.0 RECOMMENDATION:

IT IS RECOMMENDED THAT THE COMMISSION AWARD THREE INITIAL LICENSES AND THAT AN ADDITIONAL TWO BE HELD IN ABEYANCE FOR TWO YEARS. AFTER THAT TIME, THE COMMISSION SHOULD AWARD AN ADDITIONAL SET OF LICENSES, SUBJECT ONLY TO THE PROVEN VIABILITY OF THE MARKET PLACE. IT SHOULD BE THE OBJECTIVE OF THE COMMISSION TO ALLOW MAXIMUM COMPETITION TO MAXIMIZE THE PUBLIC BENEFIT OF BEST PRICING.

REGIONAL VERSUS NATIONAL LICENSES

The Commentor supports the the position that a national license is inappropriate. The Commentor specifically presents a detailed analysis that it has presented to the Commission in an informal presentation as well as part of its prior filings that describes its position on national licenses.

The allocation of frequencies for operation of PCN licenses in the 1.8 to 2.2 GHz bands may be done in a variety of ways and each alternative provides advantages and disadvantages to certain groups. It is the objective of the new services goal of having an interoperable and seamless national service, in the context of a business environment that provides maximum innovation, with greatest competitiveness. These three goals of interoperability, innovation and competitiveness will ensure a world leadership role for the United States and at the same time present challenges from the policy perspective.

What is important to note is that this new service will be the first nationwide public telecommunications offering and system to

be developed and deployed after the breakup of AT&T. Thus a new paradigm for success must be developed. No such paradigm now exists, but there are several examples of lack of success. These will be used as evidence in the following policy analysis.

1. GOAL

THE GOAL OF THE ESTABLISHMENT OF NEW PCN SERVICES IS TO PROVIDE TO THE PUBLIC, SEAMLESS AND INTEROPERABLE WIRELESS TELECOMMUNICATIONS SERVICES THAT USE THE MOST INNOVATIVE TECHNOLOGY AND TECHNIQUES AND PROVIDED IN AS COMPETITIVE ENVIRONMENT AS POSSIBLE, TO ENSURE THE MAXIMUM BENEFIT TO THE CONSUMER IN THE SHORTEST TIME.

This goal is clear in that it meets the overall public good requirement that of combining market efficiencies in innovation and price, with the limited control of seamless service. There are two options that can be followed. One extreme is to require that every user in every city can use the same terminal in every other location. The other less extreme position is that a user of an allocated band may move freely from city to city with the same terminal, and remain operable in that band. These alternatives are described as follows:

OPTION 2.1

THE SEAMLESS SERVICE CAPABILITY SHOULD BE PROVIDED ACROSS THE COUNTRY IN A SEAMLESS FASHION WITHIN EACH BAND ASSIGNED AND NOT NECESSARILY BETWEEN ALL BANDS, ALLOWING THE CONSUMER ACCESS TO THE SERVICE IN ANY GEOGRAPHICAL LOCATION THROUGH AT LEAST ONE PROVIDER.

This alternative suggests that the Commission allocate several frequency bands of operation per city, and make those bands as consistent from city to city. The requirement is to have a user in one band have access to the system in any other city or location. This can be achieved in one of two ways; these are shown in OPTIONS 3.1 and 3.2.

OPTION 2.2

THE SEAMLESS SERVICE CAPABILITY SHOULD BE PROVIDED ACROSS ALL BANDS AND IN ALL CITIES AND OTHER GEOGRAPHICAL LOCATIONS, ALLOWING THE CONSUMER ACCESS TO ANY SYSTEM IN ANY LOCATION WITH THE SAME PORTABLE DEVICE.

This can be achieved in two extreme ways. The first is to mandate a single standard, ab initio, and the second

is to require a high powered and costly terminal for the consumer. The former approach will not converge in adequate time and the latter approach is unrealistic from a market perspective. Specifically, the terminal that is fully interoperable will be excessively costly. Thus, this alternative is unacceptable.

OPTION 3.1

INTERLOCATION COMPATIBILITY CAN BE ACHIEVED BY AGREEMENTS ON STANDARDS THAT ARE MET BY MANUFACTURERS AS WELL AS SERVICE PROVIDERS.

Standards provide a common specification so that terminals in one city and in the same band may be used in any other city in the same band. All locations meet the standard. This does not say, however, that all bands meet the same standard. In point of fact, the opposite may be true. In a new technology, innovative changes may be useful for the overall competitiveness of the market to have several technologies be employed and to have market forces, limited only by in-band interoperability, operate on choosing the best alternative. Point of fact, it is clear that there will be such a situation between the 800 MHz band and the 1.8 GHz bands.

Furthermore, standards, even in-band only, will stimulate manufacturers to develop a cost effective system solution to both infrastructure as well as portables. If one believes the market projections, it is clear with even a tripartition of the market by band that adequate size is available for vendors of portables if and only if a standard exists and is accepted. An in-band standard thus accomplishes two things. First it creates a base for vendors to reach scale. Second, it allows interband competition and innovation. If achieved, the in-band only standards approach represents the paradigm for the replacement of the pre-divestiture AT&T planning model. The approach to doing this is shown in OPTIONS 4.1 and 4.2.

OPTION 3.2

INTEROPERABILITY CAN BE MET ACROSS PART OR ALL BANDS AND IN ALL LOCATIONS BY MEANS OF TECHNOLOGICAL SOLUTIONS THAT ALLOW THE PORTABLE TERMINALS TO HAVE THE COMPUTER POWER TO PROCESS ALL POSSIBLE INTERFACES AND ACCESS SCHEMES.

A technical solution to interoperability requires that the terminal provided to the consumer in the shortest

time has the capability to process the received signals to be compatible for all air interfaces, all multiple access schemes, all speech compression schemes, etc. Clearly such a terminal, if achievable, is much too costly. Thus, this alternative is not acceptable.

OPTION 4.1

THE SERVICE PROVIDERS CAN BE SELECTED IN A FULL OPEN MARKET ENVIRONMENT WITH NO REQUIREMENTS FOR NATIONAL COVERAGE. USING THE ACCEPTED STANDARDS THE SERVICE PROVIDERS MAY THEN PROVIDE SAME-BAND SEAMLESS SERVICE, ALLOWING COMPETITION AND INNOVATION IN THE BETWEEN BAND SERVICES.

If one accepts standards as both necessary inevitable from the perspective of market forces alone, it is possible to assign frequencies across the country in a partitioned fashion. Specifically, local licenses can be assigned and fear of lack of interoperability can be avoided. This is because the users will agree to de facto standards. These standards agreements amongst the carriers will be driven by the ability to obtain equipment at better prices due to larger national volumes and also because the portables will be more efficiently priced and more effectively distributed. The means to accomplish this are presented in OPTIONS 5.1 and 5.2.¹³

OPTION 4.2

TO ASSURE IN-BAND SERVICE PROVIDERS ESTABLISH A SINGLE SERVICE ACROSS THE COUNTRY, A LIMITED NUMBER OF NATIONAL LICENSES SHOULD BE ISSUED.

One approach to assure rapid convergence to in-band only standards is to assign national licenses. This is necessary if and only if there is not a process discernible and actionable that allows standards to be developed and agreed to quickly and in an efficient manner. In point of fact, with the current filings for Pioneer's Preference alone, there is prima facie evidence that there are clusterings of potential service providers already converging on a single standard. For example, the CDMA approach in the 1.25 MHz bandwidth is one of several considered. Thus, by

13. Several Experimental license holders are currently amending their licenses to be able to operate across their individual systems. These holders have selected a single technology which allows them to do so. This step is an existence proof that a national seamless interoperable network functions with coalitions. A second, and not so obvious proof, is the movement in the Cellular world, where the CTIA finally accepted CDMA as a second standard. Given the current lack of market success of TDMA, this standard could easily become a general wireless standard.

the existence of this aggregation on a single technology amongst a set of independent filers, convergence is possible and is already occurring.

A few national licenses to a few large carriers will lack the competitiveness that will occur in the more open market format and furthermore may inherently converge on delimited innovation and market dihesence. In the current 800 MHz cellular systems, the duopoly configuration reverts to an effective monopoly in many markets due to the presence of a weak or less competent competitor. Innovation is stifled, as is exemplified by the selection of TDMA in this area. **Thus, this option is unacceptable.**

OPTION 5.1

IN AN OPEN-MARKET ALTERNATIVE, AGREEMENT TO STANDARDS CAN EVOLVE WITHIN A LOOSE COALITION OF THE SAME-BAND PROVIDERS IN DIFFERENT CITIES.

Loose national coalitions are very typical. For example, in the 800 MHz band the Cellular One coalition is a Branding approach that includes commonality of some service offerings. If a similar approach could evolve around common technology alternatives, then allocation to loose coalitions is one approach to balance innovation and competition, with the needs for seamless service and interoperability. It is suggested that such a natural clustering of interests is possible and that the Commission should support this. This approach should be aggressively supported in two ways. First, filings on consortia should receive further preference, and second, the anti-competitive nature of such coalitions, delimited by antitrust laws should be reviewed and consideration made to allow such an approach that will be within the context of the overall public interest. The present Commentor has, with other Commentors, agreed to amend their Experimental filings to demonstrate that using QUALCOMM CDMA technology that a national network is achievable. These amendments will be forthcoming, and clearly demonstrate the ability to coalesce around a single standard.

OPTION 5.2

IN AN OPEN MARKET ALTERNATIVE, FULL FREE MARKET FORCES WILL BE USED TO ALLOW THE CONSUMER TO DETERMINE THE BEST SOLUTION, PROVIDING NO GUIDELINES TO SERVICE PROVIDERS.

A full free and open market will not be stable and cannot effectively exist. The natural instability of this approach suggests that it not be followed.

6.0 RECOMMENDATION

THE RECOMMENDATION IS TO REQUIRE IN-BAND INTEROPERABILITY, THROUGH STANDARDS, DEVELOPED THROUGH A LIMITED NUMBER OF COALITIONS OR CONSORTIA, BUT PROVIDING MAXIMUM COMPETITIVENESS AMONGST ALL VIABLE ENTRANTS, AND ALLOWING INTERBAND COMPETITIVENESS VIA TECHNOLOGY AND OPERATIONAL EFFICIENCIES. FURTHERMORE, IT IS RECOMMENDED THAT NO NATIONAL LICENSE BE ISSUED TO ANY CONTENDER AND THAT MARKET FORCES BE ALLOWED TO GENERATE THE MARKET.

LOTTERY VERSUS COMPETITIVE BIDDING

The issue of lottery versus a competitive bid is clearly at the heart of establishing a truly competitive market.

(i) A clear and measurable value exist for each frequency allocation based upon the perceived market and the expected costs. The value is based upon perceived revenue flows, based upon price and price alone, and price is based upon operational efficiencies in both labor and capital. Therefore the most labor and capital efficient player can pay the highest price for the system. This is in the best interests of the consumer.

(ii) It is recognized that in any competitive market, no matter how many contenders, the top three contenders are the dominant players in the market. Their dominance is based upon their ability to sell the product and this ability is based on quality and price. Assuming equal quality, price alone is the determinant in a commodifiable market. Thus value and in turn the bid reservation price is a purely competitive factor.

(iii) Value is not diluted by more players, this is a result of the three dominant players observation.

(iv) Qualified contenders for the frequency bands are required, since those not qualified may bid high and thus not allow true providers to enter. Thus to be qualified means that the contender must be both competent and committed. Competence is based on experience, demonstrated by such things as Experimental Trials or Technology contributions. Commitment is

reflected in a commitment to operate in a short period of time or suffer loss of the license.

Based upon these observations, and based upon the Goal established for the PCN services, the argument proceeds as follows:

1. GOAL

THE GOAL OF THE ESTABLISHMENT OF NEW PCN SERVICES IS TO PROVIDE TO THE PUBLIC, SEAMLESS AND INTEROPERABLE WIRELESS TELECOMMUNICATIONS SERVICES THAT USE THE MOST INNOVATIVE TECHNOLOGY AND TECHNIQUES AND PROVIDED IN AS COMPETITIVE ENVIRONMENT AS POSSIBLE, TO ENSURE THE MAXIMUM BENEFIT TO THE CONSUMER IN THE SHORTEST TIME.

OPTION 2.1

PROVIDE FOR A COMPETITIVE BIDDING PROCESS WHEREIN EACH CONTENDER WILL BID FOR THE FREQUENCIES ON A MARKET BY MARKET BASIS.

Competitive bidding provides a basis to allow the true value of the asset to be measured and returned to the owner of the asset, in this case the public. Further, competitive bidding, though its revenue generation ability, can establish a fund from which the Government can and should and should initially establish and support the underlying industry technical support so critical for the success of this business. In addition, competitive bidding is the only true way for the Government to ascertain the best and most enduring players in this field. From the point of view of best, the process, if rationally pursued, allows each contender to take their pool of capital asset and apply them to each bid in such a fashion that is closest to or equal to their reservation price, such prices reflecting the true value of the asset.

Their reservation price is based upon three factors; their expected rate of return, their anticipated revenue growth, and their expected operational capabilities. The rate of return is clearly an individual factor, but based on comparable market rates for the level of risk, it is anticipated that each rational investor, will, in the large, converge on similar rates of return. The revenue goal is based upon the anticipated price that the competition can offer and their expected relative price to their competitors. Assuming that a competitor is equally efficient, then the demand is relatively well understood by all parties. Thus, from a competitive bid aspect, rates of return and revenue are equal to all competitors. The only differentiating determinant is the operational costs. The